CLAIMS

1. A magnetic recording medium comprising at least a non-magnetic undercoat layer, a first magnetic layer, a non-magnetic coupling layer, a second magnetic layer, and a protective layer, in this order, on a non-magnetic substrate,

wherein the second magnetic layer is anti-ferromagnetically coupled with the first magnetic layer; and

the first magnetic layer is made of a CoCrZr alloy.

2. A magnetic recording medium comprising at least a non-magnetic undercoat layer, a first magnetic layer, a non-magnetic coupling layer, a second magnetic layer, a non-magnetic coupling layer, a third magnetic layer, and a protective layer, in this order, on a non-magnetic substrate,

wherein the third magnetic layer is antiferromagnetically coupled with the second magnetic layer;

the second magnetic layer is antiferromagnetically coupled with the first magnetic layer; and

the first magnetic layer is made of a CoCrZr alloy.

3. A magnetic recording medium according to claim 1 or 2, wherein the first magnetic layer contains 5 to 22 at.% of Cr and 1 to 10 at.% of Zr.

4. A magnetic recording medium according to any one of claims 1 to 3, wherein the thickness of the first magnetic layer is in a range of 0.5 to 10 nm.

5. A magnetic recording medium according to any one of claims 1 to 4, wherein the non-magnetic coupling layer is made of at least one of Ru, Rh, Ir, Cr, Re, an Ru-based alloy, an Rh-based alloy, an Ir-based alloy, a Cr-based alloy, and an Re-based alloy; and the thickness of the non-magnetic coupling layer is in a range of 0.5 to 1.5 nm.

6. A magnetic recording medium according to any one of claims 1 to 5, wherein the non-magnetic undercoat layer has a multi-layer structure comprising a layer made of Cr or a layer made of a Cr-based alloy containing Cr and at least one of Ti, Mo, Al, Ta, W, Ni,

B, Si, and V.

7. A magnetic recording medium according to any one of claims 1 to 5, wherein the non-magnetic undercoat layer has a multi-layer structure comprising a layer containing one of NiAl-based alloy, RuAl-based alloy, and Cr-based alloy; and the Cr-based alloy contains Cr and one or two or greater of Ti, Mo, Al, Ta, W, Ni, B, Si, and V.

8. A magnetic recording medium according to any one of claims 1 to 7, wherein the non-magnetic substrate is one of a glass substrate and a silicon substrate.

9. A magnetic recording medium according to any one of claims 1 to 8, wherein the non-magnetic substrate comprises a substrate made of one of Al, an Al-based alloy, glass, and silicon; on which a film containing one of NiP and an NiP alloy is formed.

10. A magnetic recording medium according to any one of claims 1 to 9, wherein the second magnetic layer is made of at least one of a CoCrTa-based alloy, a CoCrPtTa-based alloy, a CoCrPtB-based alloy, and a CoCrPtBM-based alloy (wherein M denotes at least one of Ta and Cu).

11. A magnetic recording medium according to any one of claims 2 to 9, wherein the second magnetic layer and the third magnetic layer are made of at least one of a CoCrTa-based alloy, a CoCrPtTa-based alloy, a CoCrPtB-based alloy, and a CoCrPtBM-based alloy (wherein M denotes at least one of Ta and Cu).

12. A method for producing a magnetic recording medium comprising at least a non-magnetic undercoat layer, a first magnetic layer, a non-magnetic coupling layer, a second magnetic layer, and a protective layer, in this order, on a non-magnetic substrate, and the second magnetic layer being antiferromagnetically coupled with the first magnetic layer,

wherein the method comprises the step in which the first magnetic layer is made of a CoCrZr alloy.

13. A method for producing a magnetic recording medium comprising at least a

non-magnetic undercoat layer, a first magnetic layer, a non-magnetic coupling layer, a second magnetic layer, a non-magnetic coupling layer, a third magnetic layer, and a protective layer, in this order, on a non-magnetic substrate, the third magnetic layer being antiferromagnetically coupled with the second magnetic layer, and the second magnetic layer being antiferromagnetically coupled with the first magnetic layer,

wherein the method comprises the step in which the first magnetic layer is made of a CoCrZr alloy.

14. A magnetic recording and reproducing apparatus comprising a magnetic recording medium according to any one of claims 1 to 11 and a magnetic head for recording information in the magnetic recording medium and reproducing information from the magnetic recording medium.